1. NAME/ORGANIZATION

Town of Marana

2. PROJECT TITLE

Ina Road Bridge West of Interstate 10 in Pima County, Arizona

3. INTRODUCTION

Proposal Purpose

The purpose of this proposal is to request RTA Wildlife Linkages funding for construction of wildlife linkage structures as part of the Ina Road Bridge replacement project. The project is located in Township 12 South, Range 12 East, portions of Sections 35 and 36, and Township 13 South, Range 12 East, portions of Sections 1 and 2 (Exhibit A). The project will attach two Maberry “Bat Bridge Condos” (Exhibit B) to the existing Cortaro Road Bridge prior to construction on the Ina Road Bridge, and will incorporate nine bat roost structures into the new, east-bound Ina Road Bridge.

Project Background

The existing single bridge structure and associated vehicle capacity of the Ina Road Bridge have been determined to be inadequate, and there are concerns about the integrity of the bridge and grade control structure in relation to periodic flood events. To address these issues, the Town plans a two phase construction project. In the first phase, the plan is to construct a new nine-span, AASHTO Type III Girder, two-lane bridge for east-bound traffic, upstream of the existing Ina Road Bridge. The bridge will be approximately 630 feet in length between the banks of the Santa Cruz River, with sixteen piers (eight sets of two) in the Santa Cruz River. There will be nine spans (distance between piers). The spans at each end will be 68 feet-9 inches long and each of the remaining seven (7) spans will be 70 feet in length. The width of the bridge will be 43 feet. Nine bat structures will be incorporated into the new bridge (Exhibit C).

During the second phase, the existing Ina Road Bridge will be demolished and replaced with a new nine-span, AASHTO Type III Girder, two-lane bridge for west-bound traffic. The dimensions of this bridge will be the same as described above for the first bridge.
In addition to construction of the new bridges and demolition of the old bridge, construction of new approaches and bank protection, and rehabilitation of the grade control structure will be included in this project.

The project area is located over the Santa Cruz River, near the Tucson Mountains, in Pima County, Arizona. The Ina Road Bridge also provides wildlife habitat, and is known to provide important roosting habitat for several bat species, including cave myotis (*Myotis velifer*) and Mexican free-tailed bats (*Tadarida brasiliensis*) during the summer, and for a smaller number of Mexican free-tailed bats during the winter. The Ina Road Bridge also provides crucial stop-over roosts for bats migrating longer distances, which may include Mexican free-tailed bats and cave myotis, and for species which may be moving shorter distances to hibernacula, such as big brown bats and several other species of myotis bats.

There is abundant riparian habitat upstream (south) of the existing Ina Road Bridge, consisting of willows (*Salix* sp.), cottonwood (*Populus fremontii*), non-native salt cedar (*Tamarix* sp.), seep willow (*Baccharis salicifolia*), and other riparian species. Some additional riparian habitat also occurs downstream (north) of the bridge. The water and riparian areas provide an important prey source for foraging insectivorous bats.

**Background: Bridges as Important Wildlife Linkages for Bats:**

- Bridges provide roosting locations that tie large blocks of foraging habitat together, and in this manner, can act as wildlife linkages for bat species, providing access to life history needs at the local scale and on a daily basis.

- Roost sites facilitating migration are part of the wildlife movement patterns addressed by the RTA Wildlife Linkages Committee. Bridges provide open space or rest stops along migration pathways and provide protection from terrestrial predators.

- Some of the bat species using bridges in Tucson are migratory; thus, migratory roosts provide important stop-over roosting and foraging habitats for migrating bats.

- Bat migration includes both long-distance migration of thousands of miles as bats move between summer maternity areas and wintering areas, as well as shorter movements by species moving between summer maternity areas and winter hibernating roosts. Bats making such movements need migration roosts to provide areas where they can rest and gather resources to support their physiological needs during migration.

- Tucson-area bridges provide important day roosts, maternity roosts, and night roosts for at least eight species of bats (Sandy Wolf, pers. comm. Feb. 2012). The older bridge designs provided crevices for bats to roost; however, as these bridges are being replaced, new designs are being used, like the AASHTO Type III Girder bridges being used for Ina Road, that are flat-bottomed slabs which do not provide suitable crevices for bats’ use. As a result, bat roosting habitat is being lost.
• Day roosting bats and maternity colonies often seek out the crevices between box beam girders or expansion joints in bridges.

• Amid widespread urbanization, suitable bat roosting sites are often limited. The AZ Department of Transportation website states that “Bridges frequently offer valuable habitat for bats, typically in the narrow joints between vertical elements such as girders. For this reason, the design team should consider providing alternate habitats for soffit fill bridges (bridges with no exposed girders or other structural elements).”

• The conservation of bat maternity roosts for both migratory and non-migratory species is essential to the maintenance and recovery of bat populations. Many bat species have just one pup per year and have a lifespan of up to twenty years, so the loss of each bat roost is significant.

• More than 50 percent of American bat species are in severe decline or already appear on the endangered species list (Bat Conservation International website www.batcon.org), and their conservation and recovery is dependent on access to forage and roost resources.

The value of bridges in providing important bat roost habitat is evident by the occupancy of the majority of bridges in the Tucson area by bats, including the Ina Road Bridge. This value has been recognized by the local community as is apparent by the popular bat-viewing evenings held at various bridges around the community.

The benefits of accommodating bats in transportation structures include pest control—some small insectivorous bats can consume up to 2,000 mosquito-sized insects in one night. Bats are also a vital part of the Sonoran Desert Ecosystem; some species pollinate columnar cacti and agave.

The Arizona Game and Fish Department (AZGFD) On-line Review Tool, accessed November 29, 2011, lists “bat colony” under Special Status Species, and includes the California leaf-nosed bat (Macrotrus californicus) and cave myotis (Myotis velifer) as occurring within three miles of the Ina Road Bridge. The Online Review Tool states:

“...During the planning stages of your project, please consider the local or regional needs of wildlife in regards to movement, connectivity, and access to habitat needs. Loss of this permeability prevents wildlife from accessing resources, finding mates, reduces gene flow, prevents wildlife from re-colonizing areas where local extirpations may have occurred, and ultimately prevents wildlife from contributing to ecosystem functions, such as pollination, seed dispersal, control of prey numbers, and resistance to invasive species. In many cases, streams and washes provide natural movement corridors for wildlife and should be maintained in their natural state...To minimize impacts to birds and bats, as well as aquatic species, consider conducting maintenance and construction activities outside the breeding/maternity season (breeding seasons
for birds and bats usually occur spring - summer). If bats are present, maintenance and construction (including paving and milling) activities should be conducted during nighttime hours, if possible, when the fewest number of bats will be roosting. Consider incorporating roosting habitat for bats into bridge designs.”

AZGFD (2008) provides the following information for providing bat habitat in bridges:

*To Be conducive for use by bats as day roosts, bridges should:*

- Be greater than 10 feet above the ground
- Have vertical crevices 0.5 to 1.25 inches wide
- Have vertical crevices 12 inches or greater in depth
- Be sealed from rainwater and debris from entering from above
- Have full sun exposure of the structure
- Not be situated over busy roadways passing underneath the structure

*Night roosts are used mostly between 10pm and midnight, but some are used throughout the night for periodic rest between feeding. Bats are attracted to bridges that:*

- Have a large thermal mass that remains warm at night
- Have vertical concrete surfaces located between beams that provide protection from wind and remain warm at night

The Town has coordinated with several bat experts, including AZGFD biologists, U.S. Fish and Wildlife Service biologists, Bat Conservation International, the Arizona Western Bat Resource Group, local contract biologists, and transportation officials, as well as bat biologists in California, to determine how best to create habitat with similar structure, temperature and humidity ranges to those of known bat roosts in Tucson, specifically, the Ina Road Bridge. Although plans for add-on bat roost structures are available and were considered, there were questions regarding the usefulness or effectiveness of such structures in the extreme heat of the Sonoran Desert.

Concrete bridges moderate temperatures, provide temperature consistency, and provide protection from weather. The large thermal mass of bridges protects roosting bats from high temperatures during the day and retains warmth at night.

**Proposed Project**

The Town worked with Premier Engineering and RS Engineering to create a design that incorporates bat habitat into the new bridge structure, rather than using a retrofitted add-on structure (Exhibit C). This approach was selected in order to provide more thermal mass to moderate temperatures and more closely replicate the existing conditions of the current Ina Road Bridge.

The new Ina Road Bridge consists of AASHTO Type III girders with an 8 inch deck. The deck will be thickened between girders from 8 to 23 inches to accommodate the 14 inch...
crevices in the bat structures. The thickened deck has plan view dimensions of 5 feet long by approximately 6 feet wide. The bat boxes provide slots that are 14 inches deep by 48 inches long. The width of the crevices will be varied, with some boxes having ¾-inch slats, some having 1 inch slats, and some having 1 ¼-inch slats. These boxes are placed in close proximity to the pier supports in order to retain the resulting bending moment within the bending moment capacity of the proposed girders. A total of nine “boxes” would be needed to accommodate approximately 30,000 bats, based on a requirement of approximately 3 cubic inches per bat (Tim Snow pers. comm. Dec. 19, 2011). This should provide sufficient roost space to accommodate the current number of bats using the existing Ina Road Bridge.

Data loggers will be installed in the existing bat roosts in the Ina Road Bridge, to determine relative humidity and temperature in the roosts currently used by bats. This will provide important baseline data for comparison to post-construction conditions. Comparison with baseline conditions is important because it will allow us to determine the effectiveness of the new design in recreating existing bat roost conditions. Such knowledge will allow us to find the most effective way to create bat roosting habitat and provide the opportunity to apply this knowledge to other projects in the future.

In addition to incorporating bat habitat into the east-bound bridge; two bat boxes, with a capacity of approximately 2,000 bats each, will be retrofitted to the Cortaro Rd. Bridge, which is one mile north of the Ina Road Bridge. This will be completed prior to construction activities at the Ina Road Bridge and will provide additional, alternative roosting habitat in proximity to the Ina Road Bridge in the event that noise disturbance and construction activity cause some bats to abandon the Ina Road Bridge during construction. Because roosting sites are limited, it is crucial to provide alternative roosting habitat for the bats that currently use the Ina Road Bridge.

Prior to demolition of the existing Ina Road Bridge, bats must be excluded to avoid mortalities. Exclusion should be performed between October and March, when bat population numbers in the bridge are at their lowest (Scott Richardson, USFWS, pers. comm. May 2011). During the exclusion process, a biologist will conduct nightly monitoring for 7 consecutive nights, immediately prior to demolition, to assure all bats are excluded prior to construction and to limit the potential for reoccupancy. Weekly monitoring will be employed to ensure bats do not becoming entangled in the wire netting or other exclusion material while these are in place, and to ensure new roosting areas on the existing bridge are not being used prior to demolition. Exhibit D includes a detailed proposal by the Arizona Game and Fish Department for monitoring and the exclusion process.

So that we can obtain as much information as possible related to the effectiveness of this project, data loggers will be installed in the new bat habitat once the new Ina Road Bridge is in place. Data loggers will also be installed in the bat boxes placed under
Cortaro Road Bridge in order to determine how closely conditions approximate those of the currently existing bat roosts in the existing Ina Road Bridge.

Post-construction monitoring will aid in determining whether any adjustments need to be made to improve effectiveness of the bat roosting structures. Bat usage will be documented by determining the numbers of each bat species and the time of year the bridge roosts and Maberry Bat Boxes are occupied. This occupancy information can be related to data logger information collected on climate conditions, as well as to the baseline conditions that were collected pre-construction. This will help us determine the effectiveness of this project and provide information that can be applied to future projects.

**Ramifications of no action**

If funding is not approved for this project, an important bat roosting site for thousands of bats at Ina Road Bridge will be demolished. The Town will not receive the guidance of bat experts on appropriate strategies to maintain important bat habitat when the Ina Road Bridge is demolished and replaced. As more of the older bridges are replaced in the Tucson Basin, the cumulative effect of loss of bat roosting habitat on bat populations could be severe. This project and the follow-up monitoring will provide valuable data for future bridge replacement projects.

Natural bat roosts in caves and mines are increasingly impacted by recreational users and mine closures. As a result, bridges may play an even more important role as roosting habitat in the future (Shawn Lowery, pers. comm. April 2012). Bridges provide important linkages for bats because they provide roosting habitat for migratory bat species as they move long distances during migration, as well as for local movements within the Tucson Basin, and they increase connectivity between foraging habitat by providing roosts in proximity to available forage resources.

4. **OBJECTIVES**

The objectives of this construction project are to:

- In order to obtain baseline data for comparative purposes, install data loggers in the existing bat habitat in the Ina Road Bridge to determine relative humidity and temperature in the roosts used by bats at Ina Road and monitor bat species composition during each season and numbers currently using the Ina Road Bridge.

- Add two Maberry Bat Boxes © to the Cortaro Road Bridge, which can house up to 2,000 bats each, at least six months prior to commencement of work on the Ina Road Bridge. Data loggers will be installed in the Maberry Bat Boxes to record microclimate conditions. Liquefied bat guano will be sprayed into crevices to encourage bat use.
• Ina Road Bridge demolition should be scheduled between October and March when the least number of bats should be present. Prior to demolition of the existing Ina Road Bridge, bats must be excluded to avoid mortalities.

• The new east-bound Ina Road Bridge deck will be thickened near the piers in an area 5 feet long by approximately 6 feet wide, in order to hold the extra weight of the bat boxes.

• Incorporate nine bat roosts, with adequate capacity to potentially accommodate up to 30,000 bats, in the new the east-bound Ina Road Bridge, which is scheduled to be constructed before the existing bridge is demolished. The bat boxes will have slots that are 14 inches deep by 48 inches long. The width of the crevices within the bat boxes will be varied, with some boxes having ¾-inch slats, some having 1 inch slats, and some having 1 ¼ -inch slats. Spray liquefied bat guano in new crevices to encourage bat use.

• Install data loggers in the bat habitat incorporated in the new Ina Road Bridge to determine effectiveness of the design and for comparative purposes with baseline data.

• Monitor bat species and numbers, along with temperature and relative humidity in the bat roosts at Cortaro Road and Ina Road Bridges for two full years after completion of construction at the Ina Road Bridge. Two years of post-construction monitoring are necessary because there may be a lag effect associated with the discovery and establishment of the new roost sites by bats. If there is indeed a lag effect (i.e., it takes time for bats to establish to 'new' surroundings) surveying for only one season post-construction may lead to false conclusions that the roost sites are not suitable, thereby suggesting adaptive management strategies that may not be necessary.

5. APPROACH

If the funding request is approved, the Town will use this money to pay for the exclusion and monitoring of bats to avoid incidental take; to acquire and install Maberry bat boxes; to complete bat habitat construction in the new bridge; and to conduct pre-and post-construction monitoring.

Incorporation of the bat habitat into the Ina Road Bridge and bat boxes at the Cortaro Road Bridge will comply with recommendations from the U.S. Fish and Wildlife Service and the Arizona Game and Fish Department to mitigate for the loss of important bat habitat in the existing Ina Road Bridge.

The current project funding is not sufficient to fully fund the construction of the new bridges and include the additional wildlife linkage structures (bat roosts). RTA funding would allow this unique approach to bat habitat linkages to be implemented, achieving not only the current linkage objectives, but also providing information that can be used to inform the approach of future projects.
6. FINAL DELIVERABLES

The final deliverables for this project are to install two Maberry Bat Boxes in Cortaro Road Bridge and nine bat roosting structures in the east-bound Ina Road Bridge. A post-construction monitoring report from AZGFD will be provided to this RTA committee, once the first year of post-construction monitoring is completed, and a final report two years following completion of the project. In addition, interim updates can be provided to the RTA, as requested, during the duration of this project.

7. TIME TABLE

The schedule listed in the table below is tentative. The Town of Marana will be responsible for the design phase and, potentially, ADOT will be responsible for the construction phase.

Table 2. Construction Phases

<table>
<thead>
<tr>
<th>Phase</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>One year prior to Phase 1 – Commence monitoring bats and</td>
<td>Summer 2013</td>
</tr>
<tr>
<td>existing roosts at Ina Road Bridge</td>
<td></td>
</tr>
<tr>
<td>Prior to Phase 1 – Install (2) Maberry Bat Bridge Condos at</td>
<td>Fall 2013</td>
</tr>
<tr>
<td>Cortaro Rd. Bridge</td>
<td></td>
</tr>
<tr>
<td>Phase 1 – Construction of new east-bound bridge north of</td>
<td>Late fall of 2015</td>
</tr>
<tr>
<td>the existing Ina Rd. Bridge with bat roosts</td>
<td></td>
</tr>
<tr>
<td>1 Week prior to initiation of Phase 2 – exclude bats from</td>
<td>Between Oct. and March</td>
</tr>
<tr>
<td>existing Ina Rd. Bridge</td>
<td>of 2016</td>
</tr>
<tr>
<td>Phase 2 – Demolition of existing Ina Rd. Bridge</td>
<td>Late fall 2016</td>
</tr>
<tr>
<td>Phase 3 – Construction of new west-bound bridge</td>
<td>Fall 2017</td>
</tr>
<tr>
<td>Monitor new bat roosts at Ina Rd. and Cortaro Rd. bridges for 2 full years post-construction</td>
<td>2017</td>
</tr>
</tbody>
</table>

8. BUDGET SUMMARY

An intergovernmental agreement will be developed with the RTA to coordinate funding. The Town of Marana is not self-certified to construct the bridge, so Marana will be responsible for Phase I: the design of bat roosts, pre-construction monitoring to determine conditions necessary to emulate in the new bridge, and installation of the Maberry Bat Bridge Condos © to provide alternative habitat for bats that are disturbed by construction of the first Ina Road Bridge prior to demolition of the existing bridge.

The construction of the bridges, Phase II, will involve an agency that is self-certified (yet to be identified), which will include bat exclusion from the existing bridge, monitoring the construction/installation of bat crevices in the new Ina Road Bridge.
The Town of Marana will also be responsible for Phase III, the post-construction monitoring of the new bat habitat at the Cortaro and Ina Road Bridges, which will provide information on whether the constructed bat habitat is being used and if not, what can be done to make the roosts more effective as bat habitat (i.e. adaptive management).

**Table 3. Costs for Bat Exclusion, Bat Habitat and Monitoring**

<table>
<thead>
<tr>
<th>Phase I – IGA between Town of Marana and the RTA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Design of Ina Rd. Bridge bat roosts</td>
<td>$5,500.</td>
</tr>
<tr>
<td>(2) Maberry Bat Bridge Condos © at $4,215.00/each</td>
<td>$8,430.</td>
</tr>
<tr>
<td>Shipping Costs</td>
<td>$1,000.</td>
</tr>
<tr>
<td>Installation of Maberry Bat Bridge Condos with data loggers</td>
<td>$2,401.</td>
</tr>
<tr>
<td>Bat exit counts and installation of data loggers on existing Ina Rd. Bridge by AZGFD</td>
<td>$13,171.</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$30,502.</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase II – IGA with a Self-certified Agency and the RTA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclude bats from Ina Rd. Bridge</td>
<td>$3,217.</td>
</tr>
<tr>
<td>Monitor construction/installation of the bat crevices on new Ina Rd. Bridge</td>
<td>$1,824.</td>
</tr>
<tr>
<td>Bat roost construction costs for Ina Rd. Bridge</td>
<td>$5,000.</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$10,041.</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase III – IGA between Town of Marana and the RTA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bat exit counts and collection of data from data loggers for both Ina and Cortaro Rd. Bridge bat roosts for two years after new bat habitat is installed.</td>
<td>$35,411.</td>
</tr>
<tr>
<td>Final report available to RTA Wildlife Linkages Committee</td>
<td>$4,607.</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$40,018.</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Total Costs for All Phases</strong></th>
<th><strong>$80,561.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>In Kind: Town of Marana coordination with design engineers, bat biologists, contract development, etc.</td>
<td>$15,000.</td>
</tr>
<tr>
<td>In Kind: AZ Game and Fish Dept. equipment (pre-project investigation of bat use, trapping equipment, ladders, Hobo data loggers, etc.)</td>
<td>$5,200.</td>
</tr>
<tr>
<td><strong>Total In-Kind</strong></td>
<td><strong>$20,200.</strong></td>
</tr>
</tbody>
</table>
9. PRINCIPAL INVESTIGATORS/ORGANIZATIONAL EXPERIENCE

Evaluation:
Shawn Lowery, Arizona Game and Fish Department, Wildlife Specialist II
Joel Diamond, Arizona Game and Fish Department, Wildlife Specialist II
Michael Ingraldi, Arizona Game and Fish Department, Project Supervisor
Sandy Wolf, Private Consulting Bat Biologist

Project Design:
Premier Engineering
RS Engineering

Project Management:
Janine Spencer, Town of Marana, Environmental Projects Coordinator
Jennifer Christelman, Town of Marana, Environmental Engineering Division Manager

10. LIST OF COOPERATORS

The project is located in the Town of Marana, Pima County. The Town of Marana will be taking the lead on this project for the design and ADOT will take the lead on the construction phase.

Arizona Game and Fish Department, Research Branch
2221 West Greenway Road
Phoenix, AZ 85023

U.S. Fish and Wildlife Service
Tucson Field Office
201 North Bonita, Suite 141
Tucson, AZ 85745
11. REFERENCES


Arizona Game and Fish Department (AZGFD) Guidelines for Bridge Construction or Maintenance to Accommodate Fish & Wildlife Movement and Passage. Arizona Game and Fish Department, Habitat Branch. November 2008


EcoPlan Associates, Inc. 2012. Draft Houghton Road widening at Union Pacific Railroad: bat roosts and mitigation measures. STP-TUC-0(201)A 0000 PM TUC SS624 01C. Tucson, AZ.


Maberry Bat Bridge Condos. Website accessed on October 2, 2011 at: www.maberrybat.com
Exhibit A – Location Map
Exhibit B – Maberry Bat Bridge Condos

http://www.maberrybat.com
**"Bridge Condo"**

<table>
<thead>
<tr>
<th><strong>Dimensions:</strong></th>
<th>26 1/2&quot; height x 20 1/4&quot; width x 38&quot; length</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight:</strong></td>
<td>approx. 210 lbs.</td>
</tr>
<tr>
<td><strong>Capacity:</strong></td>
<td>Designed for 2,000 + bats -- depending on species</td>
</tr>
<tr>
<td><strong>Construction:</strong></td>
<td>Factory galvanized steel, durable PVC plastic, polypropylene black webbing, stainless steel rivets &amp; stucco (inside), cadmium plated hardware (exterior), stainless available.</td>
</tr>
<tr>
<td><strong>Miscellaneous:</strong></td>
<td>Roosting area contains 728 feet (both sides of webbing). Louvered vents &amp; attic passageways provide maximum air circulation.</td>
</tr>
</tbody>
</table>

The "Bridge Condo" is designed as a hanging unit, (as shown in the photo at right), and features a factory galvanized welded steel outer shell with louvered vents, for air circulation. The right side picture is the bottom view of the inside (PVC) plastic insert. It shows the numerous compartments with polypropylene webbing attached with stainless steel rivets. This results in abundant roosting space, (36 chambers), and for the future growth of the colony. It is designed to accommodate approximately 2,000 + bats, depending upon species, and can be utilized under a bridge, other structure or as a free-standing outside unit. Shipping weight: 249 lbs. Price: $4,215.00
The inside is a PVC insert containing seven bat house sections. Insulation is sandwiched on the top and between the outside and inside walls to stabilize temperatures (illustration below).

The picture below illustrates 1 of 7 sections that complete the inside of the Bridge Condo, showing the large attic and access spaces to various compartments. Attic design and vents allow air flow throughout and provides additional temperature range by occupants.
Exhibit C – Ina Road Bridge Deck Plans
with Bat Roosts Incorporated
1. Bat Habitats shall be installed on the EB Bridge. See OMC S-0.12 for location.

2. All concrete backer board shall be ¾” thick with no chemical treatments. The concrete backer board shall be fire-resistant, moisture-resistant, and mild resistant.

3. Permanent 1” square blocks of concrete or concrete backer board shall be installed at the location and spacing shown to provide permanent rigidity to the slats. The blocks shall be secured to the slats using stainless steel nails.

4. The frame shall be secured to the concrete using 3” long stainless steel nails. One row of nails shall be used on each side of each frame. The nails shall be spaced at 1” maximum horizontal spacing. The nails shall be installed before the concrete is poured.

5. The contractor shall provide temporary support in the open spaces during the concrete pour to prevent collapsing or deforming the slats. The temporary supports shall be removed after the concrete has cured.

6. An inspector shall be on site during the installation of the Bat Habitats to ensure that they are constructed according to these details and notes.

7. The cost of the concrete for the Bat Habitats shall be measured and paid under the Structural Concrete (Class SI I’c = 4500 psi) pay item. The reinforcing steel for the Bat Habitats shall be measured and paid under the Reinforcing Steel pay item, all other materials and labor associated with the Bat Habitats shall be measured and shall be considered incidental to the Structural Concrete (Class SI I’c = 4500 psi) pay item.
Background and Justification

The Town of Marana is developing plans for the construction of the new Ina Road Bridge with specific design criteria to accommodate bat populations and the installation of ‘Maberry Bat Bridge Condos on the Cortaro Farms Bridge as mitigation of habitat loss during the Ina Road Bridge construction activities. The project area is located in the Town of Marana at the Ina Road and Cortaro Farms Road bridge crossings over the Santa Cruz River (Figure 1). The Ina Road bridge structure has historically provided year round roosting habitat for colonial bat species within the area including but not limited to, (Cave myotis (Myotis velifer) and Mexican freetailed bats (Tadarida brasiliensis)). The Town has the opportunity to maintain and enhance bat habitat through augmenting construction design features that benefit and attract bat populations. To inform the success of this project, microclimate data is needed to determine what habitat conditions specific species of bats utilize so as to design the most efficient roost structures that facilitate their use. In addition, bats are protected by state statute (A.R.S. Title 17) and all efforts need to be implemented that minimize the taking of bats during bridge construction activities.

If funding is not approved for this project, the Town of Marana and Arizona Department of Transportation (hereafter, ADOT) will not receive expert guidance on the appropriate strategies to maintain and enhance bat habitat along bridges that are scheduled for re-construction. This process includes pre and post-monitoring of these structures to determine the efficacy of these methodologies for the benefit of bat populations and bridge construction in Pima County and the southwest. In addition, the guidelines developed from this pilot project will ensure specifications for the type and location of appropriate bat roost structures that would allow for the safe and continued use of bridges as important wildlife roosting habitat. The lack of funding for projects like this will lead to a potential increase in wildlife mortality (A.R.S. Title 17, Take violations) and loss of habitat in this area.
Objectives
The objectives of this project are:

1) Pre-construction microclimate and bat occupancy monitoring. Determine the bat species composition, abundance and microclimatic (Temp / Relative Humidity (RH)) conditions within the current Ina Road Bridge roosting sites;

2) Install Maberry Bat Bridge Condos on the Cortaro Farms Bridge prior to disturbance to the Ina Road Bridge;

3) Coordinate and implement bat exclusion at the Ina Road Bridge before and during construction to avoid wildlife take;

4) Monitor the construction/installation of the bat crevices on the new Ina Road Bridge, and;

5) Post-construction monitoring of the environmental conditions and bat species use at the Ina Road and Cortaro Farms Bridges to ensure adequate roost habitat criteria are met.

Approach
Objective 1: Prior to the Ina Road bridge demolition, we will monitor the number of bats using the bridge structure as roosting habitat once every 4 weeks for one year prior to bridge reconstruction. We will explore the use of infrared lighting and DVR’s to estimate bat numbers, as well as evaluate the option of using visual day time roost count techniques (e.g., daytime visual counts of bridge crevices with the aid of a spot light and binoculars). We will use similar count methodology for two consecutive years post bridge construction. Pre-bridge construction bat numbers and species composition will be compared to post construction bat use numbers and species composition in order to evaluate the success of bat habitat engineered into bridge construction. In addition, we will note the type of roost use (e.g., maternity, bachelor, etc.) by bats.

In addition, to document microclimatic variability driving site occupancy by bats, we will place HOBO temperature and relative humidity data loggers within the current bat habitat on the Ina Road Bridge. These data will provide a baseline range of environmental conditions suitable for roosting bats that we will strive to mimic within the newly constructed bat replacement roosts. Roosting bats have specific environmental conditions that if not met will result in the rejection of potential roost habitat.

Objective 2: We will assist the Town of Marana and ADOT in determining the best placement for the Maberry bat condos on the Cortaro Farms Road Bridge and in determining if modifications to the Maberry bat condos are necessary. With guidance from the Town of Marana and ADOT for anchor placement on the Cortaro Farms Bridge, we will install these bat condos prior to the demolition of the Ina Road Bridge.

Objective 3: Prior to the initiation of the demolition of Ina Road bridge, (i.e., outside of the maternity season; March-September); we will exclude bats from the bridge structure beginning 5 days prior to demolition. During the night, after the bats emerge from their diurnal roosts on the Ina Rd. Bridge RTA.
bridge (about 1 hour after sunset), we will attach ¼ inch wire mesh or spray foam sealant at the entrances to all the observed roost sites. In addition, all potential roost sites on the bridge structure not observed to have bats will be sealed. All caution will be used to make sure that all bats have emerged from the roost before the application of wire mesh or foam (e.g., we will use flexible fiber optic inspection scopes to aid in identifying bats within hard to observe areas). We will accomplish this with the aid of ladders and an aerial work platform (i.e., mobile cherry picker). We will monitor the return of bats throughout the evening until 1 hour after sunrise to ensure that all the roost sites have been blocked. We will monitor the emergence of any bats we may have missed from the bridge structure for the following two nights and cap any potential identified roost sites.

**Objective 4:** We will work with the bridge construction contractor to identify the timeline for bat habitat specific construction activities of the Ina Road Bridge. We will meet with the contractor during the construction process to ensure the correct design criteria are met for the development of bridge bat habitat as specified in bridge design. This includes specific placement and interior crevice dimensions of roosting habitat that is accepted by the bat species detected during pre-surveys and historic survey efforts of the Ina Road Bridge.

**Objective 5:** We will monitor bat use (abundance, species, and type of use) of the boxes year-round from time of installation up to 2 years post-construction of new habitat on the Ina Rd Bridge. We will install, monitor and analyze microclimatic data from the environmental data loggers to ensure that the proper ranges of microclimatic conditions are met within these constructed roosts. We will use a monitoring and adaptive management approach to modify any bat roost structure that fail to provide the proper range of environmental conditions.

**Deliverables:** A final report will be prepared that addresses each of the goals and objectives listed above. All guidance and design provided will take into account current land use and development plans on adjacent lands bordering the roadway. Reference will be provided to help guide construction design of these bat roost structures, as needed and available. The final report for this project will also include guidelines for applying these bridge construction modifications methodologies as mitigation strategies for bridge design regionally.

Guidelines from this case study will include information on the following variables; (1) current habitat conditions used by bats on the Ina Bridge – crack size and depth, temp, relative humidity, (2) current species composition and numbers by season, (3) description of the exclusion process including modifications for future projects, (4) recommendations for placement of artificial bat structures as retrofits on bridges regionally based on occupation success of Cortaro Farms Bridge (5) monitoring results and rate of occupation of new crevices in the new Ina Bridge bat crevice design.
### Time Table

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Exit count monitoring at Ina Road bridge structure and install microclimatic monitors</td>
<td>Commence one year prior to Ina Road Bridge demolition</td>
</tr>
<tr>
<td>2. Install Maberry Bat Bridge Condos and attached data loggers</td>
<td>Prior to Ina Road Bridge demolition</td>
</tr>
<tr>
<td>3. Exclude bats from Ina Road bridge prior to demolition</td>
<td>1 week prior to Ina Road Bridge demolition</td>
</tr>
<tr>
<td>4. Monitor the construction/installation of the bat crevices on the new Ina Road Bridge</td>
<td>During new Ina Road Bridge construction</td>
</tr>
<tr>
<td>5. Monitor bat species composition, abundance and microclimatic conditions at newly constructed roost sites on the new Ina Road Bridge and Cortaro Farms bat Condos</td>
<td>2 years post construction</td>
</tr>
<tr>
<td>6. Provide annual progress report and presentation to RTA group and provide final report</td>
<td>End of Year 1 and Year 2</td>
</tr>
</tbody>
</table>

### Budget Details

<table>
<thead>
<tr>
<th>Task</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Exit count monitoring at Ina Road bridge structure and install microclimatic monitors</td>
<td>13,171</td>
</tr>
<tr>
<td>2. Install Maberry Bat Bridge Condos and attach data loggers</td>
<td>2401</td>
</tr>
<tr>
<td>3. Exclude bats from Ina Road bridge prior to demolition</td>
<td>3217</td>
</tr>
<tr>
<td>4. Monitor the construction/installation of the bat crevices on the new Ina Road Bridge</td>
<td>1824</td>
</tr>
<tr>
<td>5. Monitor bat species composition, abundance and microclimatic conditions at newly constructed roost sites on the new Ina Road Bridge and Cortaro Farms bat Condos</td>
<td>35,411</td>
</tr>
<tr>
<td>6. Provide annual progress report and presentation to RTA group and provide final report</td>
<td>4607</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$60,631</strong></td>
</tr>
</tbody>
</table>

**Note:** AGFD In-Kind Contributions (Use of trapping equipment, ladders, Hobo loggers, 4 DVR’s, climbing equipment, etc.) = $5200.

**Cooperators:**
Town of Marana – Project is located in the Town of Marana which is providing project design and oversight.
Premier Engineering- Providing Engineering services and design criteria for bat roosts on Ina Road Bridge.
RS Engineering - Providing Engineering services.
Ina Rd. Bridge RTA
Wildlife Linkages Proposal 7-10-12